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translation of an article entitled "Influence of Alloy Elements on High Temperature Strength of Chromium-Nickel Austenite" written by A M Borzdyka which appeared in "Doklady Akademii Nauk SSSR", Vol 63, 1948, No 3, pages 265-267. This article contains an evaluation of (long-time) creep test data obtained on austenitic Fe-Cr-Ni alloys for influence of alloy elements on results and an explanation of the difference in effect of Cr and Ni, on the one hand, and Mo, W, Cb and Ti, on the other hand, upon the creep strength.

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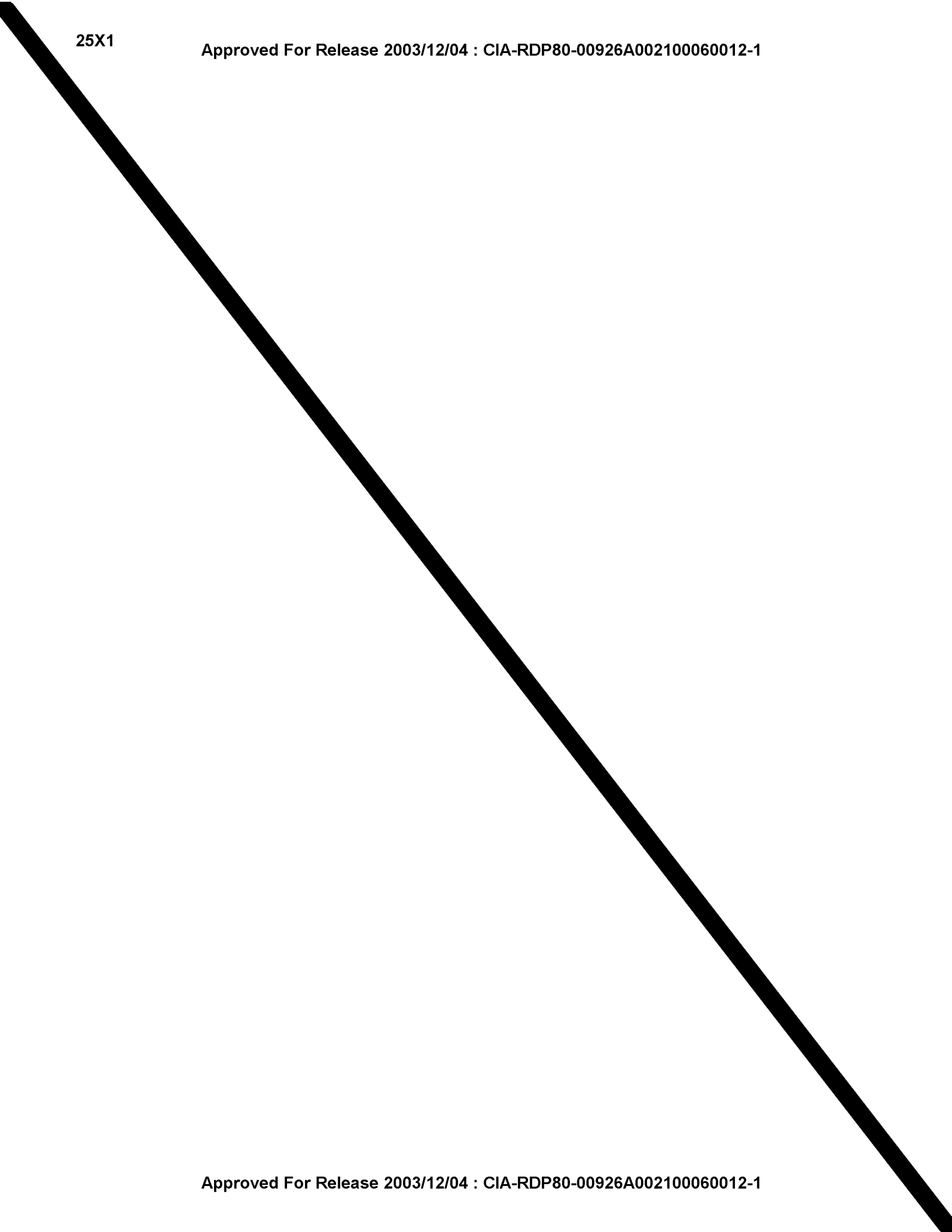

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ILLEGIB

INFLUENCE OF ALLOY ELEMENTS ON HIGH TEMPERATURE STRENGTH OF CHROMIUM-NICKEL AUSTENITE.

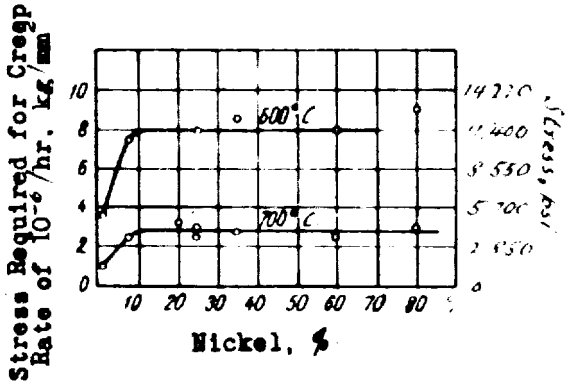

Fig. 1. Influence of nickel on creep strength of Fe-Cr-Ni alloys containing 20% Cr.

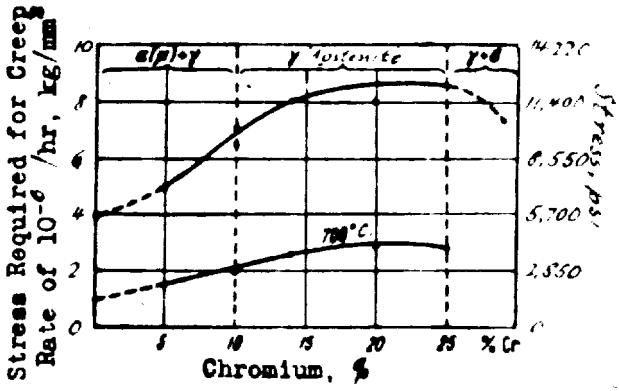

Fig. 2. Influence of chromium on creep strength of Fe-Cr-Ni alloys with 15% Ni.

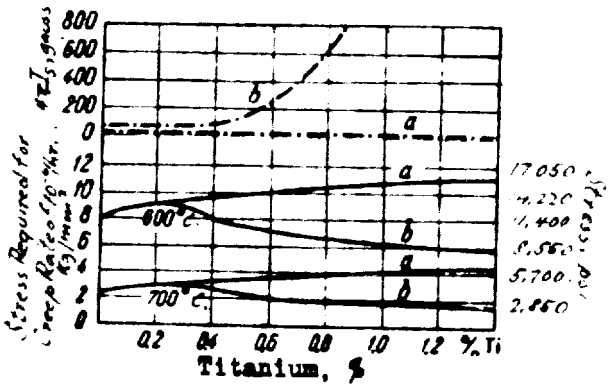

Fig. 3. Influence of titanium on creep strength of 14-14 steel (a) and 3[illegible] steel (b).

INFLUENCE OF ALLOY ELEMENTS ON HIGH TEMPERATURE STRENGTH OF CHROMIUM-NICKEL AUSTENITE

By A. M. Borzdyka

[Translated from DOKLADY AKADEMII NAUK SSSR, vol. 63, 1948, No. 3, pages 265-267]

S y n o p s i s:

Evaluation of (long-time) creep test data obtained on austenitic Fe-Cr-Ni alloys for influence of alloy elements on results.

Explanation of the cause of the difference in effect of Cr and Ni, on the one hand, and Mo, W, Cb, and Ti, on the other hand, upon the creep strength.

As early as in prewar days, a systematic study of the effect of alloy elements upon the high temperature strength of iron-chromium-nickel alloys was carried on by the author.(1) As a basic criterion, creep was selected in this study, being a

property of decisive importance for the useful life of alloys exposed to high temperatures in service. Inasmuch as the creep tests were conducted according to the classic, i.e. the long-time method, this study required considerable time and was completed only in 1947.

The present communication deals with alloys from the region of the gamma solid solutions of the ternary Fe-Cr-Ni system. The basic composition of such alloys varies within rather wide limits, that is, 10-28% Cr, 8-60% Ni, balance Fe.

The tests carried out showed that if the structural and technological factors are reduced to a single denominator, the content of basic components exerts on the creep of a ternary solid solution an effect that is considerably smaller than one may expect from the results obtained in short-time tests.

If the creep resistance (at constant temperature) of a series of iron-chromium-nickel alloys having constant chromium and increasing nickel contents is considered, this relationship may be expressed by a creep stress vs. nickel content diagram. Such a diagram, which is a particular case of the composition vs. property diagrams originated by N. S. Kurnakov, member of the Academy, is presented in Fig. 1 for the cross section with 20% Cr at the temperatures of 600 and 700° C (1110 and 1290° F). In this connection, the stress required for a creep rate of 10^{-6} in/in per hour has been selected as "creep limit". Starting with 8-10% nickel, i.e. at the moment the gamma solid solution region is entered, the curve exhibits a perfectly horizontal course

In Figure 2, analogous curves for chromium are shown, the nickel content being maintained constant at 15%. It is evident that chromium exerts a much stronger effect than Ni. However, the influence of this element, too, is slight within the gamma solution region. Thus, the variation in the absolute value of the creep limit does not exceed 2 kg/mm² (2845 psi) at 600° C (1110° F) and 1 kg/mm² (1420° F) at 700° C (1290° F), if the chromium content is increased from 10 to 25 percent.

The slight influence of the basic components of the ternary solid solution upon the creep is evidently attributable to the similarity in the atomic diameters of these components (see Table 1).

Table 1.

Element	Atomic Diam.	*	Crystal Lattice
Gamma iron	[illegible]		Face-centered cubic
Chromium	[illegible]		Body-centered cubic
Manganese	[illegible]	[illegible]	Complex
Nickel	[illegible]	[illegible]	Face-centered cubic
Cobalt	[illegible]	[illegible]	" " "
Molybdenum	[illegible]	[illegible]	Body-centered cubic
Tungsten	[illegible]	[illegible]	" " "
Columbium	[illegible]	[illegible]	" " "
Titanium	[illegible]	[illegible]	Hexagonal

* Difference from atomic diam. of Fe, %.

Indeed, the strength-increasing effect of the atoms of an element in solution is connected with the amount of deformation caused by these atoms in the crystal lattice of the solvent. The greater the similarity between the atomic volumes of solvent and solute, the more similar is the effect of the

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USSR

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USSR

Character of Composition vs Property Curves of Metallurgical Solid Solutions at High Temperatures

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1949

translation of an article entitled "On Character of Composition vs Property Curves of Metallurgical Solid Solutions at High Temperatures" by A M Borzdyka which appeared in "Doklady Akademii Nauk SSSR", Vol 65, 1949, No 4, at pages 505-507. This article contains a study of applicability of relationships established for atmospheric temperature between chemical composition and properties of solid solution alloys to conditions prevailing in high temperature service. Alloys studied: Fe-Ni; Fe-Cr-Ni, also Fe-Cr-Mn. Properties studied: Creep strength, hardness, conductivity - Conclusions to be drawn.

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